$$\tan\alpha=\tan\beta+\frac{\pi M_c}{2M_s\cos^2\beta}.$$

Knowing α, the other quantities may be found.

176. Proposed by A. H. HOLMES, Brunswick, Me.

A solid cube weighs 300 pounds. If a power is applied at an angle of 45° at an upper edge of the cube, how many foot-pounds will be required to overturn the cube?

Solution by CHRISTIAN HORNUNG, A. M., Heidelberg University, Tiffin, Ohio.

In order to overturn the cube it must be revolved on a lower edge until the center of mass is vertically over that edge, and this will require the lifting of the 300 pounds through a distance $a(\sqrt{2}-1)$, a being the edge of the cube, against gravity.

$\therefore$ the work done$=300a(\sqrt{2}-1)=124.26a$ foot-pounds. Hence, the *size* of the cube can not be left out of the calculation.

178. Proposed by F. ANDEREGG, A. M., Professor of Mathematics, Oberlin College, Oberlin, O.

A weight W is drawn up a rough conical hill of height h and slope α. and the path cuts all the lines of greatest slope at the constant angle ϕ. Find the work done in attaining the summit.

[Problem 11, page 226, *Johnson's Theoretical Mechanics.*]

Solution by G. W. GREENWOOD, M. A. (Oxon), Lebanon, Ill.

The weight W can be resolved in forces $W\cos\alpha$ perpendicular to the surface, $W\sin\alpha\cos\phi$ along its path, and $W\sin\alpha\sin\phi$ perpendicular to these directions. The force required to move the body is therefore $\mu W\cos\alpha+W\sin\alpha\cos\phi$.

The path is the equiangular spiral $s=r\sec\phi$, and hence its length from the foot of the hill is $n\operatorname{cosec}\alpha\sec\phi$.

The work done is then

$$n\operatorname{cosec}\alpha\sec\phi(\mu W\cos\alpha+W\sin\alpha\cos\phi);\ i.\ e.,\ Wh(\mu\cot\alpha\sec\phi+1).$$

179. Proposed by F. P. MATZ, Sc. D., Ph. D., Reading, Pa.

If the *velocity* of a body moving under an acceleration tending to the center *varies* as the radius of curvature, the body will describe a cycloid.

Solution by the PROPOSER.

Assume $x=\text{ver-sin}^{-1}(y)-\sqrt{(2ry-y^2)}$ to represent the orbit; then $R,=v,=2\sqrt{(2ry)}$, which fulfills the conditions of the problem.